



US009125354B2

(12) **United States Patent**  
**Johnson**

(10) **Patent No.:** **US 9,125,354 B2**  
(45) **Date of Patent:** **Sep. 8, 2015**

(54) **SQUASH HYBRID LEBEHH9044 AND PARENTS THEREOF**

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(\*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 250 days.

(21) Appl. No.: **13/628,028**

(22) Filed: **Sep. 26, 2012**

(65) **Prior Publication Data**

US 2013/0192136 A1 Aug. 1, 2013

**Related U.S. Application Data**

(60) Provisional application No. 61/593,236, filed on Jan. 31, 2012.

(51) **Int. Cl.**  
**A01H 5/08** (2006.01)

(52) **U.S. Cl.**  
CPC ..... **A01H 5/08** (2013.01)

(58) **Field of Classification Search**  
None  
See application file for complete search history.

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Variety specific information as indicated in transmittal letter of Apr. 22, 2013 Information Disclosure Statement for U.S. Appl. No. 13/628,028.

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(57) **ABSTRACT**

The invention provides seed and plants of squash hybrid LEBEHH9044 and the parent lines thereof. The invention thus relates to the plants, seeds and tissue cultures of squash hybrid LEBEHH9044 and the parent lines thereof, and to methods for producing a squash plant produced by crossing such plants with themselves or with another squash plant, such as a plant of another genotype. The invention further relates to seeds and plants produced by such crossing. The invention further relates to parts of such plants, including the fruit and gametes of such plants.

**33 Claims, No Drawings**

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# **SQUASH HYBRID LEBEHH9044 AND PARENTS THEREOF**

## **CROSS-REFERENCE TO RELATED APPLICATIONS**

This application claims the priority of U.S. Provisional Appl. Ser. No. 61/593,236, filed Jan. 31, 2012, the entire disclosure of which is incorporated herein by reference.

## **FIELD OF THE INVENTION**

The present invention relates to the field of plant breeding and, more specifically, to the development of squash hybrid LEBEHH9044 and the inbred squash lines ZGN-EH-09-7554 and LEB-48-811.

## **BACKGROUND OF THE INVENTION**

The goal of vegetable breeding is to combine various desirable traits in a single variety/hybrid. Such desirable traits may include any trait deemed beneficial by a grower and/or consumer, including greater yield, resistance to insects or disease, tolerance to environmental stress, and nutritional value.

Breeding techniques take advantage of a plant's method of pollination. There are two general methods of pollination: a plant self-pollinates if pollen from one flower is transferred to the same or another flower of the same plant or plant variety. A plant cross-pollinates if pollen comes to it from a flower of a different plant variety.

Plants that have been self-pollinated and selected for type over many generations become homozygous at almost all gene loci and produce a uniform population of true breeding progeny, a homozygous plant. A cross between two such homozygous plants of different genotypes produces a uniform population of hybrid plants that are heterozygous for many gene loci. Conversely, a cross of two plants each heterozygous at a number of loci produces a population of hybrid plants that differ genetically and are not uniform. The resulting non-uniformity makes performance unpredictable.

The development of uniform varieties requires the development of homozygous inbred plants, the crossing of these inbred plants, and the evaluation of the crosses. Pedigree breeding and recurrent selection are examples of breeding methods that have been used to develop inbred plants from breeding populations. Those breeding methods combine the genetic backgrounds from two or more plants or various other broad-based sources into breeding pools from which new lines and hybrids derived therefrom are developed by selfing and selection of desired phenotypes. The new lines and hybrids are evaluated to determine which of those have commercial potential.

## **SUMMARY OF THE INVENTION**

In one aspect, the present invention provides a squash plant of the hybrid designated LEBEHH9044, the squash line ZGN-EH-09-7554 or squash line LEB-48-811. Also provided are squash plants having all the physiological and morphological characteristics of such a plant. Parts of these squash plants are also provided, for example, including pollen, an ovule, scion, a rootstock, a fruit, and a cell of the plant.

In another aspect of the invention, a plant of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 comprising an added heritable trait is provided. The heritable trait may comprise a genetic locus that is, for example, a dominant or recessive allele. In one embodiment

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of the invention, a plant of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 is defined as comprising a single locus conversion. In specific embodiments of the invention, an added genetic locus confers one or more traits such as, for example, herbicide tolerance, insect resistance, disease resistance, and modified carbohydrate metabolism. In further embodiments, the trait may be conferred by a naturally occurring gene introduced into the genome of a line by backcrossing, a natural or induced mutation, or a transgene introduced through genetic transformation techniques into the plant or a progenitor of any previous generation thereof. When introduced through transformation, a genetic locus may comprise one or more genes integrated at a single chromosomal location.

The invention also concerns the seed of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811. The squash seed of the invention may be provided as an essentially homogeneous population of squash seed of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811. Essentially homogeneous populations of seed are generally free from substantial numbers of other seed. Therefore, seed of hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 may be defined as forming at least about 97% of the total seed, including at least about 98%, 99% or more of the seed. The seed population may be separately grown to provide an essentially homogeneous population of squash plants designated LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811.

In yet another aspect of the invention, a tissue culture of regenerable cells of a squash plant of hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 is provided. The tissue culture will preferably be capable of regenerating squash plants capable of expressing all of the physiological and morphological characteristics of the starting plant, and of regenerating plants having substantially the same genotype as the starting plant. Examples of some of the physiological and morphological characteristics of the hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 include those traits set forth in the tables herein. The regenerable cells in such tissue cultures may be derived, for example, from embryos, meristems, cotyledons, pollen, leaves, anthers, roots, root tips, pistils, flowers, seed and stalks. Still further, the present invention provides squash plants regenerated from a tissue culture of the invention, the plants having all the physiological and morphological characteristics of hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811.

In still yet another aspect of the invention, processes are provided for producing squash seeds, plants and fruit, which processes generally comprise crossing a first parent squash plant with a second parent squash plant, wherein at least one of the first or second parent squash plants is a plant of squash line ZGN-EH-09-7554 or squash line LEB-48-811. These processes may be further exemplified as processes for preparing hybrid squash seed or plants, wherein a first squash plant is crossed with a second squash plant of a different, distinct genotype to provide a hybrid that has, as one of its parents, a plant of squash line ZGN-EH-09-7554 or squash line LEB-48-811. In these processes, crossing will result in the production of seed. The seed production occurs regardless of whether the seed is collected or not.

In one embodiment of the invention, the first step in "crossing" comprises planting seeds of a first and second parent squash plant, often in proximity so that pollination will occur for example, mediated by insect vectors. Alternatively, pollen can be transferred manually. Where the plant is self-poll-

nated, pollination may occur without the need for direct human intervention other than plant cultivation.

A second step may comprise cultivating or growing the seeds of first and second parent squash plants into plants that bear flowers. A third step may comprise preventing self-pollination of the plants, such as by emasculating the flowers (i.e., killing or removing the pollen).

A fourth step for a hybrid cross may comprise cross-pollination between the first and second parent squash plants. Yet another step comprises harvesting the seeds from at least one of the parent squash plants. The harvested seed can be grown to produce a squash plant or hybrid squash plant.

The present invention also provides the squash seeds and plants produced by a process that comprises crossing a first parent squash plant with a second parent squash plant, wherein at least one of the first or second parent squash plants is a plant of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811. In one embodiment of the invention, squash seed and plants produced by the process are first generation ( $F_1$ ) hybrid squash seed and plants produced by crossing a plant in accordance with the invention with another, distinct plant. The present invention further contemplates plant parts of such an  $F_1$  hybrid squash plant, and methods of use thereof. Therefore, certain exemplary embodiments of the invention provide an  $F_1$  hybrid squash plant and seed thereof.

In still yet another aspect, the present invention provides a method of producing a plant derived from hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811, the method comprising the steps of: (a) preparing a progeny plant derived from hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811, wherein said preparing comprises crossing a plant of the hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 with a second plant; and (b) crossing the progeny plant with itself or a second plant to produce a seed of a progeny plant of a subsequent generation. In further embodiments, the method may additionally comprise: (c) growing a progeny plant of a subsequent generation from said seed of a progeny plant of a subsequent generation and crossing the progeny plant of a subsequent generation with itself or a second plant; and repeating the steps for an additional 3-10 generations to produce a plant derived from hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811. The plant derived from hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 may be an inbred line, and the aforementioned repeated crossing steps may be defined as comprising sufficient inbreeding to produce the inbred line. In the method, it may be desirable to select particular plants resulting from step (c) for continued crossing according to steps (b) and (c). By selecting plants having one or more desirable traits, a plant derived from hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 is obtained which possesses some of the desirable traits of the line/hybrid as well as potentially other selected traits.

In certain embodiments, the present invention provides a method of producing food or feed comprising: (a) obtaining a plant of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811, wherein the plant has been cultivated to maturity, and (b) collecting at least one squash from the plant.

In still yet another aspect of the invention, the genetic complement of squash hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 is provided. The phrase "genetic complement" is used to refer to the aggregate of nucleotide sequences, the expression of which sequences

defines the phenotype of, in the present case, a squash plant, or a cell or tissue of that plant. A genetic complement thus represents the genetic makeup of a cell, tissue or plant, and a hybrid genetic complement represents the genetic make up of a hybrid cell, tissue or plant. The invention thus provides squash plant cells that have a genetic complement in accordance with the squash plant cells disclosed herein, and seeds and plants containing such cells.

Plant genetic complements may be assessed by genetic marker profiles, and by the expression of phenotypic traits that are characteristic of the expression of the genetic complement, e.g., isozyme typing profiles. It is understood that hybrid LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 could be identified by any of the many well known techniques such as, for example, Simple Sequence Length Polymorphisms (SSLPs) (Williams et al., *Nucleic Acids Res.*, 18:6531-6535, 1990), Randomly Amplified Polymorphic DNAs (RAPDs), DNA Amplification Fingerprinting (DAF), Sequence Characterized Amplified Regions (SCARs), Arbitrary Primed Polymerase Chain Reaction (AP-PCR), Amplified Fragment Length Polymorphisms (AFLPs) (EP 534 858, specifically incorporated herein by reference in its entirety), and Single Nucleotide Polymorphisms (SNPs) (Wang et al., *Science*, 280:1077-1082, 1998).

In still yet another aspect, the present invention provides hybrid genetic complements, as represented by squash plant cells, tissues, plants, and seeds, formed by the combination of a haploid genetic complement of a squash plant of the invention with a haploid genetic complement of a second squash plant, preferably, another, distinct squash plant. In another aspect, the present invention provides a squash plant regenerated from a tissue culture that comprises a hybrid genetic complement of this invention.

Any embodiment discussed herein with respect to one aspect of the invention applies to other aspects of the invention as well, unless specifically noted.

The term "about" is used to indicate that a value includes the standard deviation of the mean for the device or method being employed to determine the value. The use of the term "or" in the claims is used to mean "and/or" unless explicitly indicated to refer to alternatives only or the alternatives are mutually exclusive. When used in conjunction with the word "comprising" or other open language in the claims, the words "a" and "an" denote "one or more," unless specifically noted otherwise. The terms "comprise," "have" and "include" are open-ended linking verbs. Any forms or tenses of one or more of these verbs, such as "comprises," "comprising," "has," "having," "includes" and "including," are also open-ended. For example, any method that "comprises," "has" or "includes" one or more steps is not limited to possessing only those one or more steps and also covers other unlisted steps. Similarly, any plant that "comprises," "has" or "includes" one or more traits is not limited to possessing only those one or more traits and covers other unlisted traits.

Other objects, features and advantages of the present invention will become apparent from the following detailed description. It should be understood, however, that the detailed description and any specific examples provided, while indicating specific embodiments of the invention, are given by way of illustration only, since various changes and modifications within the spirit and scope of the invention will become apparent to those skilled in the art from this detailed description.

#### DETAILED DESCRIPTION OF THE INVENTION

The invention provides methods and compositions relating to plants, seeds and derivatives of squash hybrid LEBEHH9044, squash line ZGN-EH-09-7554 and squash line LEB-48-811.

Squash hybrid LEBEHH9044 is a Long Lebanese type squash with short internode length (appropriate for protected culture/high density sowing), disease resistance (*Podosphaera xanthii*, Powdery Mildew), and high yield potential compared to commercial and competitor varieties. Hybrid LEBEHH9044 has darker color fruit than market standard “Eskenerany.”

Squash hybrid LEBEHH9044 is adapted for summer openfield crop in cold-winter areas. Hybrid LEBEHH9044 is also adapted for openfield in spring or early summer season for openfield in all areas. Hybrid LEBEHH9044 is also adapted for greenhouse/plastic tunnel/nethouse cool season production.

#### A. Origin and Breeding History of Squash Hybrid LEBEHH9044

The parents of hybrid LEBEHH9044 are ZGN-EH-09-7554 and LEB-48-811. These parents were created as follows:

The female parent of LEBEHH9044, LEB-48-811, was developed through seven sequential generations of self pollination of the commercial hybrid cultivar “Eskenderany”. Selection was for fruit shape and color.

The male parent ZGN-EH-09-7554 was developed through five generations of backcrossing. The source of the

trait of interest (resistance to Powdery Mildew, ZYMV, and WMV) was a breeding line known as “C88” distributed by INRA in France. The recurrent parent was a proprietary inbred line known as ZGN-46-42 that was itself a selection from the open pollinated variety known as “Black Beauty.” Following the multiple generations of backcrossing, five generations of self-pollination were conducted to ensure uniformity of the parent line and stability of the traits.

The parent lines are uniform and stable, as is a hybrid produced therefrom. A small percentage of variants can occur within commercially acceptable limits for almost any characteristic during the course of repeated multiplication. However no variants are expected.

#### B. Physiological and Morphological Characteristics of Squash Hybrid LEBEHH9044, Squash Line ZGN-EH-09-7554 And Squash Line LEB-48-811

In accordance with one aspect of the present invention, there is provided a plant having the physiological and morphological characteristics of squash hybrid LEBEHH9044 and the parent lines thereof. A description of the physiological and morphological characteristics of such plants is presented in Tables 1-2.

TABLE 1

Physiological and Morphological Characteristics of Hybrid LEBEHH9044		
CHARACTERISTIC	LEBEHH9044	Comparison Variety Anita
1. Species	Pepo	Pepo
2. Kind/Use	squash	squash
3. Type	summer (vegetable marrow)	summer
4. Cotyledon		
length	47.5 mm	42.55 mm
width	29.5 mm	28.55 mm
apex	rounded	tapered
veining	plainly visible	plainly visible
color	medium green	medium green
color (RHS Color Chart)	137B	137A
Seedling		
shape of cotyledons	elliptic (Cora, Tivoli)	elliptic
intensity of green color of cotyledons	medium (Cora)	medium
cross section of cotyledons	straight (Sunburst)	straight
5. Mature Plant		
growth habit	bush	semi-bush
plant type	glabrous	pubescent
6. Main Stem		
cross-section shape	angled	round
diameter at mid-point of 1 <sup>st</sup> internode	22.5 mm	26.15 mm
average length	27.2 cm	45.8 cm
average number of internodes	31	33
Stem		
color	completely green (Becky)	partly green and partly yellow
intensity of green color	dark (Greyzini)	very dark
mottling	absent (Cinderella)	absent
tendrils	absent to rudimentary (Goldrush, Sylvana)	well developed
Plant		
growth habit	bush (Greyzini)	semi-trailing
branching	absent (Goldi)	absent
bush varieties only:	erect to semi-erect (Sardane)	
attitude of petiole (excluding lower external leaves)		

TABLE 1-continued

Physiological and Morphological Characteristics of Hybrid LEBEHH9044		
CHARACTERISTIC	LEBEHH9044	Comparison Variety Anita
7. Leaves		
blade shape	reniform	reniform
blade form	deep lobed	deep lobed
margin	dentate	denticulate
margin edges	frilled	frilled
average width	33.8 cm	36.2 cm
average length	26.9 cm	29.75 cm
leaf surface	blistered	blistered
dorsal surface pubescence	soft hairy	glabrous
ventral surface pubescence	soft hairy	glabrous
color	dark green	dark green
color (RHS Color Chart)	137A	147A
leaf blotching	blotched with gray	blotched with gray
leaf blade: size	medium (Ambassador)	large
leaf blade: incisions	medium (Jackpot)	medium
leaf blade: intensity of green color of upper surface	dark (Everest)	dark
leaf blade: silvery patches	present (Civac)	present
leaf blade: relative area covered by silvery patches	small (Aziz)	small
average petiole length	35 cm	38.35 cm
petiole length	medium (Goldi)	long
petiole: number of prickles	many (White Bush Scallop)	few
8. Flower		
pistillate flower: average diameter	16.1 cm	15.9 cm
pistillate flower: ovary	drum-like	drum-like
pistillate flower: average pedicel length	1.4 cm	1.7 cm
pistillate flower: margin shape	curved	curved
pistillate flower: margin edges	frilled	frilled
pistillate flower: average sepal width	1.4 mm	1.35 mm
pistillate flower: average sepal length	4.3 mm	5.4 mm
pistillate flower: color	orange	orange
pistillate flower: color (RHS Color Chart)	21A	23A
staminate flower: average sepal length	19.8 mm	16.8 mm
staminate flower: average sepal width	3.2 mm	3 mm
staminate flower: average pedicel length	85.5 mm	122.9 mm
staminate flower: color	orange	orange
female flower: ring at inner side of corolla	present (Aurore)	present
female flower: color of ring at inner side of corolla	green (Aurore, Early White Bush Scallop, President)	green
female flower: intensity of green color of ring at inner side of corolla (varieties with green ring at inner side of corolla)	medium (Samba, Senator)	medium
male flower: ring at inner side of corolla	present (Goldi)	present
male flower: color of ring at inner side of corolla	green (Austral, Belor, Goldi)	green
male flower: intensity of green color of ring at inner side of corolla	strong (Goldi)	medium
staminate flower: color	N25C	17A
9. Fruit		
market maturity: average length	17.7 cm	13.3 cm
market maturity: average width - stem end	2.1 cm	3.1 cm
at market maturity: average width - blossom end	1.3 cm	3 cm

TABLE 1-continued

Physiological and Morphological Characteristics of Hybrid LEBEHH9044		
CHARACTERISTIC	LEBEHH9044	Comparison Variety Anita
market maturity: average weight	252.4 gm	236.5 gm
market maturity: shape	straightneck	straightneck
according to variety type		
market maturity: apex	rounded	flattened
market maturity: base	rounded	rounded
market maturity: ribs	inconspicuous	inconspicuous
market maturity: rib	shallow	shallow
furrow depth		
market maturity: rib	medium wide	narrow
furrow width		
market maturity: fruit surface	smooth	smooth
market maturity: warts	none	none
market maturity: blossom	slightly extended	raised acorn
scar button		
young fruit: ratio length/maximum diameter	large (Carlotta)	medium
(zucchini type varieties)		
young fruit: general shape	cylindrical (Ambassador, Ibis)	tapered elliptical
(zucchini and rounded zucchini type varieties)		
young fruit: main color of skin (excluding color of ribs or grooves)	green (Elite, Opal, Romano)	green
young fruit: intensity of green color of skin (only varieties with green color of skin)	very light (Clarita, Goya, Patty Green Tint)	light
general shape	cylindrical	club shaped
length (zucchini type varieties)	long (Carlotta)	medium
maximum diameter	large (Jericho, Spidy)	medium
(zucchini type varieties)		
ratio length/maximum diameter (zucchini type varieties)	large (Carlotta)	medium
blossom end (zucchini and neck type varieties)	rounded	rounded
grooves	absent	absent
ribs	present	present
protrusion of ribs	weak (Ambassador)	weak
main color of skin (excluding color of dots, patches, stripes and bands)	green (Ambassador, Baby Bear)	green
intensity of green color of skin (only varieties with green color of skin)	very light	light
dots	present (Gold Rush, Table Queen)	present
size of main dots	medium (Grey Zucchini)	small
warts on skin	absent	absent
size of flower scar	medium (Spidi)	large
length of peduncle	medium (Cinderella)	medium
color of peduncle	green (Ambassador)	green
intensity of green color of peduncle	medium (Sunburst)	medium
mottling of peduncle	present (Elite)	absent
ripe fruit: secondary color of skin (excluding color of mottles, patches, stripes and bands)	yellow (Gold Rush)	yellow
ripe fruit: intensity of main color of skin (only yellow and orange)	medium	light
ripe fruit: color of flesh	cream (Elite)	cream
ripe fruit: lignified rind	present (Elite, Little Gem, Scallopini, Yellow Summer Crookneck)	present
ripe fruit: structure of flesh	fibrous (Vegetable Spaghetti)	fibrous

TABLE 1-continued

Physiological and Morphological Characteristics of Hybrid LEBEHH9044		
CHARACTERISTIC	LEBEHH9044	Comparison Variety Anita
10. Rind		
average thickness at medial	2.7 mm	2.5 mm
toughness	hard	hard
overall color pattern	regular	regular
main or ground color	yellow	orangish-yellow
main or ground color (RHS Color Chart)	11A	18A
11. Flesh		
average blossom end thickness	49.9 mm	29.45 mm
average medial thickness	44.9 mm	52.8 mm
average stem end thickness	42.1 mm	26.25 mm
texture (fine, granular, lumpy or stringy)	fine	fine
texture (soft, firm or brittle)	soft	firm
texture (dry, moist or juicy)	juicy	juicy
flavor	slightly sweet	sweet
quality	good	excellent
color	creamy-white	greenish-white
color (RHS Color Chart)	150D	157D
12. Seed Cavity		
average length	37.2 cm	25.5 cm
average width	5.6 cm	8.7 cm
location	conforms to fruit shape	conforms to fruit shape
placental tissue	abundant	abundant
center core	inconspicuous	inconspicuous
13. Fruit Stalks		
average length	2.1 cm	3.15 cm
average diameter	1.5 cm	2.1 cm
cross-section shape	irregular	irregular
twisting	twisted	not twisted
tapering	tapered	tapered
straightness	slightly curved	straight
texture	spongy	soft
furrows	deep	shallow
surface	rough	spiny
attachment end	slightly expanded	expanded
detaches	with difficulty	easily
color	dark green	medium green
color (RHS Color Chart)	137A	143B
14. Seeds		
average length	15.6 mm	18.6 mm
average width	9 mm	9.2 mm
average thickness	2 mm	2.8 mm
face surface	wrinkled	smooth
color	cream	white
color (RHS Color Chart)	4D	155A
luster	glossy	dull
margin	straight	curved
margin edge	wedge-like	rounded
separation from pulp	moderately easy	easy
average grams per 100 seeds	10 gm	17 gm
average number of seeds per fruit	305	342
seed coat	normal	normal
size	medium (Diamant)	large
shape	broad elliptic (Baby Boo)	elliptic
hull	present (Baby Bear, Elite)	present
appearance of hull	fully developed (Elite)	fully developed
color of hull	cream (De Nice à Fruit Rond)	cream
fruit type:	zucchini	
fruit: patches, stripes or bands in ripe stage (if zucchini type)	absent (Ambassador, Black Jack)	

\*These are typical values. Values may vary due to environment. Other values that are substantially equivalent are also within the scope of the invention.

TABLE 2

Physiological and Morphological Characteristics of Line ZGN-EH-09-7554		
CHARACTERISTIC	ZGN-EH-09-7554	Comparison Variety Payroll
1. Species	Pepo	Pepo
2. Kind/Use	squash	squash
3. Type	summer (vegetable marrow)	summer
4. Cotyledon		
length	39.8 mm	45.5 mm
width	26.8 mm	29.25 mm
apex	rounded	tapered
veining	prominent	obscure
color	dark green	medium green
color (RHS Color Chart)	137A	137A
Seedling		
shape of cotyledons	elliptic (Cora, Tivoli)	elliptic
intensity of green color of cotyledons	dark (Lidia)	medium
cross section of cotyledons	straight (Sunburst)	concave
5. Mature Plant		
growth habit	bush	bush
plant type	glabrous	pilose
6. Main Stem		
cross-section shape	angled	round
diameter at mid-point of 1 <sup>st</sup> internode	26 mm	23.4 mm
average length	28 cm	30.75 cm
average number of internodes	31	24.2
Stem		
color	completely green (Becky)	completely green
intensity of green color	dark (Greyzini)	dark
mottling	absent (Cinderella)	absent
tendrils	absent to rudimentary (Goldrush, Sylvana)	well developed
Plant		
growth habit	bush (Greyzini)	bush
branching	absent (Goldi)	absent
bush varieties only:	erect to semi-erect (Sardane)	erect
attitude of petiole (excluding lower external leaves)		
7. Leaves		
blade shape	reniform	reniform
blade form	shallow lobed	deep lobed
margin	dentate	dentate
margin edges	frilled	frilled
average width	33.5 cm	32.4 cm
average length	24.8 cm	29.1 cm
leaf surface	blistered	blistered
dorsal surface pubescence	soft hairy	soft hairy
ventral surface pubescence	soft hairy	soft hairy
color	dark green	dark green
color (RHS Color Chart)	147A	139A
leaf blotching	blotched with gray	blotched with gray
leaf blade: size	medium (Ambassador)	small
leaf blade: incisions	medium (Jackpot)	deep
leaf blade: intensity of green color of upper surface	dark (Everest)	dark
leaf blade: silvery patches	present (Civac)	present
leaf blade: relative area covered by silvery patches	medium (Ambassador)	small
average petiole length	35.2 cm	35.15 cm
petiole length	medium (Goldi)	long
petiole: number of prickles	few (Opaline)	few
8. Flower		
pistillate flower: average diameter	16 cm	15.3 cm
pistillate flower: ovary	drum-like	drum-like
pistillate flower: average pedicel length	1.4 cm	1.75 cm
pistillate flower: margin shape	curved	straight



TABLE 2-continued

Physiological and Morphological Characteristics of Line ZGN-EH-09-7554		
CHARACTERISTIC	ZGN-EH-09-7554	Comparison Variety Payroll
pistillate flower: margin edges	frilled	frilled
pistillate flower: average sepal width	1.3 mm	1.25 mm
pistillate flower: average sepal length	2.3 mm	5.25 mm
pistillate flower: color	orange	orange
pistillate flower: color (RHS Color Chart)	17A	17A
staminate flower: average sepal length	13.6 mm	18.5 mm
staminate flower: average sepal width	3 mm	2.95 mm
staminate flower: average pedicel length	87.4 mm	175 mm
staminate flower: color	orange	orange
female flower: ring at inner side of corolla	present (Aurore)	present
female flower: color of ring at inner side of corolla	green (Aurore, Early White Bush Scallop, President)	green
female flower: intensity of green color of ring at inner side of corolla (varieties with green ring at inner side of corolla)	medium (Samba, Senator)	medium
male flower: ring at inner side of corolla	present (Goldi)	present
male flower: color of ring at inner side of corolla	green (Austral, Belor, Goldi)	green
male flower: intensity of green color of ring at inner side of corolla	strong (Goldi)	strong
staminate flower: color	23A	21A
9. Fruit		
market maturity: average length	18 cm	19.05 cm
market maturity: average width - stem end	2.2 cm	3.2 cm
at market maturity: average width - blossom end	1.3 cm	1.8 cm
market maturity: average weight	240.6 gm	239 gm
market maturity: shape according to variety type	straightneck	straightneck
market maturity: apex	rounded	rounded
market maturity: base	rounded	taper pointed
market maturity: ribs	none	prominent
market maturity: fruit surface	smooth	smooth
market maturity: warts	none	none
market maturity: blossom scar button	slightly extended	raised acorn
young fruit: ratio length/maximum diameter	large (Carlotta)	large
(zucchini type varieties)		
young fruit: general shape (zucchini and rounded zucchini type varieties)	cylindrical (Ambassador, Ibis)	cylindrical
young fruit: main color of skin (excluding color of ribs or grooves)	green (Elite, Opal, Romano)	green
young fruit: intensity of green color of skin (excluding color of ribs or grooves; only varieties with green color of skin)	dark (Arlesa, Sandra, Zefira)	medium
general shape	cylindrical	cylindrical
length (zucchini type varieties)	long (Carlotta)	very long
maximum diameter (zucchini type varieties)	medium (Opal)	medium

TABLE 2-continued

Physiological and Morphological Characteristics of Line ZGN-EH-09-7554		
CHARACTERISTIC	ZGN-EH-09-7554	Comparison Variety Payroll
ratio length/maximum diameter (zucchini type varieties)	large (Carlotta)	large
blossom end (zucchini and neck type varieties)	rounded	pointed
grooves	absent	absent
ribs	absent	present
main color of skin (excluding color of dots, patches, stripes and bands)	green (Ambassador, Baby Bear)	green
intensity of green color of skin (only varieties with green color of skin)	dark (Cora)	medium
stripes in grooves	absent (Baby Bear, Jack Be Little)	absent
dots	absent (Sunburst)	present
warts on skin	absent	absent
size of flower scar	small (Goldi)	small
length of peduncle	medium (Cinderella)	short
color of peduncle	green (Ambassador)	green
intensity of green color of peduncle	dark (Gold Rush)	medium
mottling of peduncle	present (Elite)	absent
ripe fruit: secondary color of skin (excluding color of mottles, patches, stripes and bands)	yellow (Gold Rush)	yellow
ripe fruit: intensity of main color of skin (only yellow and orange)	medium	medium
ripe fruit: secondary color of skin	orange	orange
ripe fruit: color of flesh	orange (Autumn Gold)	cream
ripe fruit: lignified rind	present (Elite, Little Gem, Scallopini, Yellow Summer Crookneck)	present
ripe fruit: structure of flesh	not fibrous (Elite)	fibrous
10. Rind		
average thickness at medial	1.9 mm	1.9 mm
toughness	hard	hard
overall color pattern	regular	regular
main or ground color	green	bronze
main or ground color (RHS Color Chart)	N189A	139A
color of blotches	orange	
color of blotches (RHS Color Chart)	25A	
pattern of blotches	not specific	
11. Flesh		
average blossom end thickness	42.3 mm	22 mm
average medial thickness	43.1 mm	59 mm
average stem end thickness	41 mm	27.4 mm
texture (fine, granular, lumpy or stringy)	fine	fine
texture (soft, firm or brittle)	brittle	soft
texture (dry, moist or juicy)	moist	moist
flavor	slightly sweet	slightly sweet
quality	good	good
color	creamy-white	creamy-white
color (RHS Color Chart)	2C	151B
12. Seed Cavity		
average length	25.5 cm	28.85 cm
average width	3.7 cm	5 cm
location	conforms to fruit shape	conforms to fruit shape
placental tissue	abundant	abundant
center core	inconspicuous	inconspicuous
13. Fruit Stalks		
average length	2.1 cm	2.75 cm
average diameter	1.6 cm	2.05 cm

TABLE 2-continued

Physiological and Morphological Characteristics of Line ZGN-EH-09-7554		
CHARACTERISTIC	ZGN-EH-09-7554	Comparison Variety Payroll
cross-section shape	irregular	irregular
twisting	twisted	twisted
tapering	tapered	tapered
straightness	slightly curved	curved
texture	spongy	soft
furrows	shallow	deep
surface	rough	rough
attachment end	slightly expanded	slightly expanded
detaches	with difficulty	easily
color	dark green	medium green
color (RHS Color Chart)	136A	137B
14. Seeds		
average length	13 mm	14.4 mm
average width	8.3 mm	8.5 mm
average thickness	2.7 mm	2.75 mm
face surface	smooth	smooth
color	cream	white
color (RHS Color Chart)	155A	155A
luster	glossy	dull
margin	curved	curved
margin edge	rounded	rounded
separation from pulp	easy	easy
average grams per 100 seeds	9.3 gm	13.75 gm
average number of seeds per fruit	70	187
seed coat	normal	normal
size	medium (Diamant)	small
shape	broad elliptic (Baby Boo)	elliptic
hull	present (Baby Bear, Elite)	present
appearance of hull	fully developed (Elite)	fully developed
color of hull	cream (De Nice à Fruit Rond)	cream
fruit type:	zucchini	
fruit: patches, stripes or bands in ripe stage (if zucchini type)	present (Elite, Greyzini)	

\*These are typical values. Values may vary due to environment Other values that are substantially equivalent are also within the scope of the invention.

### C. Breeding Squash Plants

One aspect of the current invention concerns methods for producing seed of squash hybrid LEBEHH9044 involving crossing squash lines ZGN-EH-09-7554 and LEB-48-811. Alternatively, in other embodiments of the invention, hybrid LEBEHH9044, line ZGN-EH-09-7554, or line LEB-48-811 may be crossed with itself or with any second plant. Such methods can be used for propagation of hybrid LEBEHH9044 and/or the squash lines ZGN-EH-09-7554 and LEB-48-811, or can be used to produce plants that are derived from hybrid LEBEHH9044 and/or the squash lines ZGN-EH-09-7554 and LEB-48-811. Plants derived from hybrid LEBEHH9044 and/or the squash lines ZGN-EH-09-7554 and LEB-48-811 may be used, in certain embodiments, for the development of new squash varieties.

The development of new varieties using one or more starting varieties is well known in the art. In accordance with the invention, novel varieties may be created by crossing hybrid LEBEHH9044 followed by multiple generations of breeding according to such well known methods. New varieties may be created by crossing with any second plant. In selecting such a second plant to cross for the purpose of developing novel lines, it may be desired to choose those plants which either themselves exhibit one or more selected desirable characteristics or which exhibit the desired characteristic(s) when in hybrid combination. Once initial crosses have been made, inbreeding and selection take place to produce new varieties.

For development of a uniform line, often five or more generations of selfing and selection are involved.

Uniform lines of new varieties may also be developed by way of double-haploids. This technique allows the creation of true breeding lines without the need for multiple generations of selfing and selection. In this manner true breeding lines can be produced in as little as one generation. Haploid embryos may be produced from microspores, pollen, anther cultures, or ovary cultures. The haploid embryos may then be doubled autonomously, or by chemical treatments (e.g. colchicine treatment). Alternatively, haploid embryos may be grown into haploid plants and treated to induce chromosome doubling. In either case, fertile homozygous plants are obtained. In accordance with the invention, any of such techniques may be used in connection with a plant of the invention and progeny thereof to achieve a homozygous line.

Backcrossing can also be used to improve an inbred plant. Backcrossing transfers a specific desirable trait from one inbred or non-inbred source to an inbred that lacks that trait. This can be accomplished, for example, by first crossing a superior inbred (A) (recurrent parent) to a donor inbred (non-recurrent parent), which carries the appropriate locus or loci for the trait in question. The progeny of this cross are then mated back to the superior recurrent parent (A) followed by selection in the resultant progeny for the desired trait to be transferred from the non-recurrent parent. After five or more backcross generations with selection for the desired trait, the progeny have the characteristic being transferred, but are like

the superior parent for most or almost all other loci. The last backcross generation would be selfed to give pure breeding progeny for the trait being transferred.

The plants of the present invention are particularly well suited for the development of new lines based on the elite nature of the genetic background of the plants. In selecting a second plant to cross with LEBEHH9044 and/or squash lines ZGN-EH-09-7554 and LEB-48-811 for the purpose of developing novel squash lines, it will typically be preferred to choose those plants which either themselves exhibit one or more selected desirable characteristics or which exhibit the desired characteristic(s) when in hybrid combination. Examples of desirable traits may include, in specific embodiments, high seed yield, high seed germination, seedling vigor, high fruit yield, disease tolerance or resistance, and adaptability for soil and climate conditions. Consumer-driven traits, such as a fruit shape, color, texture, and taste are other examples of traits that may be incorporated into new lines of squash plants developed by this invention.

#### D. Performance Characteristics

As described above, hybrid LEBEHH9044 exhibits desirable traits, as conferred by squash lines ZGN-EH-09-7554 and LEB-48-811. The performance characteristics of hybrid LEBEHH9044 and squash lines ZGN-EH-09-7554 and LEB-48-811 were the subject of an objective analysis of the performance traits relative to other varieties. The results of the analysis are presented below.

TABLE 3

Hybrid performance data, LEBEHH9044 vs. Eskenderany, Woodland CA summer 2010 openfield, 20 harvest dates.				
Hybrid	Plant Growth Habit Score	Powdery Mildew Score	Viral Severity Score	Marketable Fruit/Plant
LEBEHH9044	2	3	4	16.6
Eskenderany	6	7	6	18.3

#### E. Further Embodiments of the Invention

In certain aspects of the invention, plants described herein are provided modified to include at least a first desired heritable trait. Such plants may, in one embodiment, be developed by a plant breeding technique called backcrossing, wherein essentially all of the morphological and physiological characteristics of a variety are recovered in addition to a genetic locus transferred into the plant via the backcrossing technique. The term single locus converted plant as used herein refers to those squash plants which are developed by a plant breeding technique called backcrossing, wherein essentially all of the morphological and physiological characteristics of a variety are recovered in addition to the single locus transferred into the variety via the backcrossing technique. By essentially all of the morphological and physiological characteristics, it is meant that the characteristics of a plant are recovered that are otherwise present when compared in the same environment, other than an occasional variant trait that might arise during backcrossing or direct introduction of a transgene.

Backcrossing methods can be used with the present invention to improve or introduce a characteristic into the present variety. The parental squash plant which contributes the locus for the desired characteristic is termed the nonrecurrent or donor parent. This terminology refers to the fact that the nonrecurrent parent is used one time in the backcross protocol and therefore does not recur. The parental squash plant to which the locus or loci from the nonrecurrent parent are

transferred is known as the recurrent parent as it is used for several rounds in the backcrossing protocol.

In a typical backcross protocol, the original variety of interest (recurrent parent) is crossed to a second variety (non-recurrent parent) that carries the single locus of interest to be transferred. The resulting progeny from this cross are then crossed again to the recurrent parent and the process is repeated until a squash plant is obtained wherein essentially all of the morphological and physiological characteristics of the recurrent parent are recovered in the converted plant, in addition to the single transferred locus from the nonrecurrent parent.

The selection of a suitable recurrent parent is an important step for a successful backcrossing procedure. The goal of a backcross protocol is to alter or substitute a single trait or characteristic in the original variety. To accomplish this, a single locus of the recurrent variety is modified or substituted with the desired locus from the nonrecurrent parent, while retaining essentially all of the rest of the desired genetic, and therefore the desired physiological and morphological constitution of the original variety. The choice of the particular nonrecurrent parent will depend on the purpose of the backcross; one of the major purposes is to add some commercially desirable trait to the plant. The exact backcrossing protocol will depend on the characteristic or trait being altered and the genetic distance between the recurrent and nonrecurrent parents. Although backcrossing methods are simplified when the characteristic being transferred is a dominant allele, a recessive allele, or an additive allele (between recessive and dominant), may also be transferred. In this instance it may be necessary to introduce a test of the progeny to determine if the desired characteristic has been successfully transferred.

In one embodiment, progeny squash plants of a backcross in which a plant described herein is the recurrent parent comprise (i) the desired trait from the non-recurrent parent and (ii) all of the physiological and morphological characteristics of squash the recurrent parent as determined at the 5% significance level when grown in the same environmental conditions.

New varieties can also be developed from more than two parents. The technique, known as modified backcrossing, uses different recurrent parents during the backcrossing. Modified backcrossing may be used to replace the original recurrent parent with a variety having certain more desirable characteristics or multiple parents may be used to obtain different desirable characteristics from each.

With the development of molecular markers associated with particular traits, it is possible to add additional traits into an established germ line, such as represented here, with the end result being substantially the same base germplasm with the addition of a new trait or traits. Molecular breeding, as described in Moose and Mumm, 2008 (Plant Physiology, 147: 969-977), for example, and elsewhere, provides a mechanism for integrating single or multiple traits or QTL into an elite line. This molecular breeding-facilitated movement of a trait or traits into an elite line may encompass incorporation of a particular genomic fragment associated with a particular trait of interest into the elite line by the mechanism of identification of the integrated genomic fragment with the use of flanking or associated marker assays. In the embodiment represented here, one, two, three or four genomic loci, for example, may be integrated into an elite line via this methodology. When this elite line containing the additional loci is further crossed with another parental elite line to produce hybrid offspring, it is possible to then incorporate at least eight separate additional loci into the hybrid. These additional loci may confer, for example, such traits as

a disease resistance or a fruit quality trait. In one embodiment, each locus may confer a separate trait. In another embodiment, loci may need to be homozygous and exist in each parent line to confer a trait in the hybrid. In yet another embodiment, multiple loci may be combined to confer a single robust phenotype of a desired trait.

Many single locus traits have been identified that are not regularly selected for in the development of a new inbred but that can be improved by backcrossing techniques. Single locus traits may or may not be transgenic; examples of these traits include, but are not limited to, herbicide resistance, resistance to bacterial, fungal, or viral disease, insect resistance, modified fatty acid or carbohydrate metabolism, and altered nutritional quality. These comprise genes generally inherited through the nucleus.

Direct selection may be applied where the single locus acts as a dominant trait. For this selection process, the progeny of the initial cross are assayed for viral resistance and/or the presence of the corresponding gene prior to the backcrossing. Selection eliminates any plants that do not have the desired gene and resistance trait, and only those plants that have the trait are used in the subsequent backcross. This process is then repeated for all additional backcross generations.

Selection of squash plants for breeding is not necessarily dependent on the phenotype of a plant and instead can be based on genetic investigations. For example, one can utilize a suitable genetic marker which is closely genetically linked to a trait of interest. One of these markers can be used to identify the presence or absence of a trait in the offspring of a particular cross, and can be used in selection of progeny for continued breeding. This technique is commonly referred to as marker assisted selection. Any other type of genetic marker or other assay which is able to identify the relative presence or absence of a trait of interest in a plant can also be useful for breeding purposes. Procedures for marker assisted selection are well known in the art. Such methods will be of particular utility in the case of recessive traits and variable phenotypes, or where conventional assays may be more expensive, time consuming or otherwise disadvantageous. Types of genetic markers which could be used in accordance with the invention include, but are not necessarily limited to, Simple Sequence Length Polymorphisms (SSLPs) (Williams et al., *Nucleic Acids Res.*, 18:6531-6535, 1990), Randomly Amplified Polymorphic DNAs (RAPDs), DNA Amplification Fingerprinting (DAF), Sequence Characterized Amplified Regions (SCARs), Arbitrary Primed Polymerase Chain Reaction (AP-PCR), Amplified Fragment Length Polymorphisms (AFLPs) (EP 534 858, specifically incorporated herein by reference in its entirety), and Single Nucleotide Polymorphisms (SNPs) (Wang et al., *Science*, 280:1077-1082, 1998).

#### F. Plants Derived by Genetic Engineering

Many useful traits that can be introduced by backcrossing, as well as directly into a plant, are those which are introduced by genetic transformation techniques. Genetic transformation may therefore be used to insert a selected transgene into a plant of the invention or may, alternatively, be used for the preparation of transgenes which can be introduced by backcrossing. Methods for the transformation of plants that are well known to those of skill in the art and applicable to many crop species include, but are not limited to, electroporation, microprojectile bombardment, *Agrobacterium*-mediated transformation and direct DNA uptake by protoplasts.

To effect transformation by electroporation, one may employ either friable tissues, such as a suspension culture of cells or embryogenic callus or alternatively one may transform immature embryos or other organized tissue directly. In this technique, one would partially degrade the cell walls of

the chosen cells by exposing them to pectin-degrading enzymes (pectolyases) or mechanically wound tissues in a controlled manner.

An efficient method for delivering transforming DNA segments to plant cells is microprojectile bombardment. In this method, particles are coated with nucleic acids and delivered into cells by a propelling force. Exemplary particles include those comprised of tungsten, platinum, and preferably, gold. For the bombardment, cells in suspension are concentrated on filters or solid culture medium. Alternatively, immature embryos or other target cells may be arranged on solid culture medium. The cells to be bombarded are positioned at an appropriate distance below the macroprojectile stopping plate.

An illustrative embodiment of a method for delivering DNA into plant cells by acceleration is the Biolistics Particle Delivery System, which can be used to propel particles coated with DNA or cells through a screen, such as a stainless steel or Nytex screen, onto a surface covered with target cells. The screen disperses the particles so that they are not delivered to the recipient cells in large aggregates. Microprojectile bombardment techniques are widely applicable, and may be used to transform virtually any plant species.

*Agrobacterium*-mediated transfer is another widely applicable system for introducing gene loci into plant cells. An advantage of the technique is that DNA can be introduced into whole plant tissues, thereby bypassing the need for regeneration of an intact plant from a protoplast. Modern *Agrobacterium* transformation vectors are capable of replication in *E. coli* as well as *Agrobacterium*, allowing for convenient manipulations (Klee et al., *Bio-Technology*, 3(7):637-642, 1985). Moreover, recent technological advances in vectors for *Agrobacterium*-mediated gene transfer have improved the arrangement of genes and restriction sites in the vectors to facilitate the construction of vectors capable of expressing various polypeptide coding genes. The vectors described have convenient multi-linker regions flanked by a promoter and a polyadenylation site for direct expression of inserted polypeptide coding genes. Additionally, *Agrobacterium* containing both armed and disarmed Ti genes can be used for transformation.

In those plant strains where *Agrobacterium*-mediated transformation is efficient, it is the method of choice because of the facile and defined nature of the gene locus transfer. The use of *Agrobacterium*-mediated plant integrating vectors to introduce DNA into plant cells is well known in the art (Fraleigh et al., *Bio/Technology*, 3:629-635, 1985; U.S. Pat. No. 5,563, 055).

Transformation of plant protoplasts also can be achieved using methods based on calcium phosphate precipitation, polyethylene glycol treatment, electroporation, and combinations of these treatments (see, e.g., Potrykus et al., *Mol. Gen. Genet.*, 199:183-188, 1985; Omirulleh et al., *Plant Mol. Biol.*, 21(3):415-428, 1993; Fromm et al., *Nature*, 312:791-793, 1986; Uchimiya et al., *Mol. Gen. Genet.*, 204:204, 1986; Marcotte et al., *Nature*, 335:454, 1988). Transformation of plants and expression of foreign genetic elements is exemplified in Choi et al. (*Plant Cell Rep.*, 13: 344-348, 1994), and Ellul et al. (*Theor. Appl. Genet.*, 107:462-469, 2003).

A number of promoters have utility for plant gene expression for any gene of interest including but not limited to selectable markers, scoreable markers, genes for pest tolerance, disease resistance, nutritional enhancements and any other gene of agronomic interest. Examples of constitutive promoters useful for plant gene expression include, but are not limited to, the cauliflower mosaic virus (CaMV) P-35S promoter, which confers constitutive, high-level expression

in most plant tissues (see, e.g., Odel et al., *Nature*, 313:810, 1985), including in monocots (see, e.g., Dekeyser et al., *Plant Cell*, 2:591, 1990; Terada and Shimamoto, *Mol. Gen. Genet.*, 220:389, 1990); a tandemly duplicated version of the CaMV 35S promoter, the enhanced 35S promoter (P-e35S); 1 the nopaline synthase promoter (An et al., *Plant Physiol.*, 88:547, 1988); the octopine synthase promoter (Fromm et al., *Plant Cell*, 1:977, 1989); and the figwort mosaic virus (P-FMV) promoter as described in U.S. Pat. No. 5,378,619 and an enhanced version of the FMV promoter (P-eFMV) where the promoter sequence of P-FMV is duplicated in tandem; 5 the cauliflower mosaic virus 19S promoter; a sugarcane bacilliform virus promoter; a commelina yellow mottle virus promoter; and other plant DNA virus promoters known to express in plant cells.

A variety of plant gene promoters that are regulated in response to environmental, hormonal, chemical, and/or developmental signals can also be used for expression of an operably linked gene in plant cells, including promoters regulated by (1) heat (Callis et al., *Plant Physiol.*, 88:965, 1988), (2) light (e.g., pea *rbcS*-3A promoter, Kuhlemeier et al., *Plant Cell*, 1:471, 1989; maize *rbcS* promoter, Schaffner and Sheen, *Plant Cell*, 3:997, 1991; or chlorophyll *a/b*-binding protein promoter, Simpson et al., *EMBO J.*, 4:2723, 1985), (3) hormones, such as abscisic acid (Marcotte et al., *Plant Cell*, 1:969, 1989), (4) wounding (e.g., wun1, Siebertz et al., *Plant Cell*, 1:961, 1989); or (5) chemicals such as methyl jasmonate, salicylic acid, or Safener. It may also be advantageous to employ organ-specific promoters (e.g., Roshal et al., *EMBO J.*, 6:1155, 1987; Scherthner et al., *EMBO J.*, 7:1249, 1988; Bustos et al., *Plant Cell*, 1:839, 1989).

Exemplary nucleic acids which may be introduced to plants of this invention include, for example, DNA sequences or genes from another species, or even genes or sequences which originate with or are present in the same species, but are incorporated into recipient cells by genetic engineering methods rather than classical reproduction or breeding techniques. However, the term "exogenous" is also intended to refer to genes that are not normally present in the cell being transformed, or perhaps simply not present in the form, structure, etc., as found in the transforming DNA segment or gene, or genes which are normally present and that one desires to express in a manner that differs from the natural expression pattern, e.g., to over-express. Thus, the term "exogenous" gene or DNA is intended to refer to any gene or DNA segment that is introduced into a recipient cell, regardless of whether a similar gene may already be present in such a cell. The type of DNA included in the exogenous DNA can include DNA which is already present in the plant cell, DNA from another plant, DNA from a different organism, or a DNA generated externally, such as a DNA sequence containing an antisense message of a gene, or a DNA sequence encoding a synthetic or modified version of a gene.

Many hundreds if not thousands of different genes are known and could potentially be introduced into a squash plant according to the invention. Non-limiting examples of particular genes and corresponding phenotypes one may choose to introduce into a squash plant include one or more genes for insect tolerance, such as a *Bacillus thuringiensis* (B.t.) gene, pest tolerance such as genes for fungal disease control, herbicide tolerance such as genes conferring glyphosate tolerance, and genes for quality improvements such as yield, nutritional enhancements, environmental or stress tolerances, or any desirable changes in plant physiology, growth, development, morphology or plant product(s). For example, structural genes would include any gene that confers insect tolerance including but not limited to a *Bacillus* insect control

protein gene as described in WO 99/31248, herein incorporated by reference in its entirety, U.S. Pat. No. 5,689,052, herein incorporated by reference in its entirety, U.S. Pat. Nos. 5,500,365 and 5,880,275, herein incorporated by reference in their entirety. In another embodiment, the structural gene can confer tolerance to the herbicide glyphosate as conferred by genes including, but not limited to *Agrobacterium* strain CP4 glyphosate resistant EPSPS gene (*aroA*:CP4) as described in U.S. Pat. No. 5,633,435, herein incorporated by reference in its entirety, or glyphosate oxidoreductase gene (GOX) as described in U.S. Pat. No. 5,463,175, herein incorporated by reference in its entirety.

Alternatively, the DNA coding sequences can affect these phenotypes by encoding a non-translatable RNA molecule that causes the targeted inhibition of expression of an endogenous gene, for example via antisense- or cosuppression-mediated mechanisms (see, for example, Bird et al., *Biotech. Gen. Engin. Rev.*, 9:207, 1991). The RNA could also be a catalytic RNA molecule (i.e., a ribozyme) engineered to cleave a desired endogenous mRNA product (see for example, Gibson and Shillito, *Mol. Biotech.*, 7:125, 1997). Thus, any gene which produces a protein or mRNA which expresses a phenotype or morphology change of interest is useful for the practice of the present invention.

#### G. Definitions

In the description and tables herein, a number of terms are used. In order to provide a clear and consistent understanding of the specification and claims, the following definitions are provided:

**Allele:** Any of one or more alternative forms of a gene locus, all of which alleles relate to one trait or characteristic. In a diploid cell or organism, the two alleles of a given gene occupy corresponding loci on a pair of homologous chromosomes.

**Backcrossing:** A process in which a breeder repeatedly crosses hybrid progeny, for example a first generation hybrid ( $F_1$ ), back to one of the parents of the hybrid progeny. Backcrossing can be used to introduce one or more single locus conversions from one genetic background into another.

**Crossing:** The mating of two parent plants.

**Cross-pollination:** Fertilization by the union of two gametes from different plants.

**Diploid:** A cell or organism having two sets of chromosomes.

**Emasculate:** The removal of plant male sex organs or the inactivation of the organs with a cytoplasmic or nuclear genetic factor or a chemical agent conferring male sterility.

**Enzymes:** Molecules which can act as catalysts in biological reactions.

**$F_1$  Hybrid:** The first generation progeny of the cross of two nonisogenic plants.

**Genotype:** The genetic constitution of a cell or organism.

**Haploid:** A cell or organism having one set of the two sets of chromosomes in a diploid.

**Linkage:** A phenomenon wherein alleles on the same chromosome tend to segregate together more often than expected by chance if their transmission was independent.

**Marker:** A readily detectable phenotype, preferably inherited in codominant fashion (both alleles at a locus in a diploid heterozygote are readily detectable), with no environmental variance component, i.e., heritability of 1.

**Phenotype:** The detectable characteristics of a cell or organism, which characteristics are the manifestation of gene expression.

Quantitative Trait Loci (QTL): Quantitative trait loci (QTL) refer to genetic loci that control to some degree numerically representable traits that are usually continuously distributed.

Resistance: As used herein, the terms “resistance” and “tolerance” are used interchangeably to describe plants that show no symptoms to a specified biotic pest, pathogen, abiotic influence or environmental condition. These terms are also used to describe plants showing some symptoms but that are still able to produce marketable product with an acceptable yield. Some plants that are referred to as resistant or tolerant are only so in the sense that they may still produce a crop, even though the plants are stunted and the yield is reduced.

Regeneration: The development of a plant from tissue culture.

Royal Horticultural Society (RHS) color chart value: The RHS color chart is a standardized reference which allows accurate identification of any color. A color's designation on the chart describes its hue, brightness and saturation. A color is precisely named by the RHS color chart by identifying the group name, sheet number and letter, e.g., Yellow-Orange Group 19A or Red Group 41B.

Self-pollination: The transfer of pollen from the anther to the stigma of the same plant.

Single Locus Converted (Conversion) Plant: Plants which are developed by a plant breeding technique called backcrossing, wherein essentially all of the morphological and physiological characteristics of a squash variety are recovered in addition to the characteristics of the single locus transferred into the variety via the backcrossing technique and/or by genetic transformation.

Substantially Equivalent: A characteristic that, when compared, does not show a statistically significant difference (e.g.,  $p=0.05$ ) from the mean.

Tissue Culture: A composition comprising isolated cells of the same or a different type or a collection of such cells organized into parts of a plant.

Transgene: A genetic locus comprising a sequence which has been introduced into the genome of a squash plant by transformation.

#### H. Deposit Information

A deposit of squash hybrid LEBEHH9044 and inbred parent line ZGN-EH-09-7554, disclosed above and recited in the claims, has been made with the American Type Culture Collection (ATCC), 10801 University Blvd., Manassas, Va. 20110-2209. The date of deposit was Feb. 21, 2012. The accession numbers for those deposited seeds of squash hybrid LEBEHH9044 and inbred parent line ZGN-EH-09-7554 are ATCC Accession No. PTA-12567, and ATCC Accession No. PTA-12566, respectively. Upon issuance of a patent, all restrictions upon the deposits will be removed, and the deposits are intended to meet all of the requirements of 37 C.F.R. §1.801-1.809. The deposits will be maintained in the depository for a period of 30 years, or 5 years after the last request, or for the effective life of the patent, whichever is longer, and will be replaced if necessary during that period.

Although the foregoing invention has been described in some detail by way of illustration and example for purposes of clarity and understanding, it will be obvious that certain changes and modifications may be practiced within the scope of the invention, as limited only by the scope of the appended claims.

All references cited herein are hereby expressly incorporated herein by reference.

What is claimed is:

1. A squash plant comprising at least a first set of the chromosomes of squash line ZGN-EH-09-7554, a sample of seed of said line having been deposited under ATCC Accession Number PTA-12566.

2. A seed comprising at least a first set of the chromosomes of squash line ZGN-EH-09-7554, a sample of seed of said line having been deposited under ATCC Accession Number PTA-12566.

3. The plant of claim 1, which is inbred.

4. The plant of claim 1, which is hybrid.

5. The seed of claim 2, which is inbred.

6. The seed of claim 2, which is hybrid.

7. The plant of claim 4, wherein the hybrid plant is squash hybrid LEBEHH9044, a sample of seed of said hybrid LEBEHH9044 having been deposited under ATCC Accession Number PTA-12567.

8. The seed of claim 6, defined as a seed of squash hybrid LEBEHH9044, a sample of seed of said hybrid LEBEHH9044 having been deposited under ATCC Accession Number PTA-12567.

9. The seed of claim 2, defined as a seed of line ZGN-EH-09-7554.

10. A plant part of the plant of claim 1.

11. The plant part of claim 10, further defined as a leaf, an ovule, pollen, a fruit, or a cell.

12. A squash plant having all the physiological and morphological characteristics of the squash plant of claim 7.

13. A tissue culture of regenerable cells of the plant of claim 1, said cells comprising at least a first set of the chromosomes of squash line ZGN-EH-09-7554, a sample of seed of said line having been deposited under ATCC Accession Number PTA-12566.

14. The tissue culture according to claim 13, comprising cells or protoplasts from a plant part selected from the group consisting of embryos, meristems, cotyledons, pollen, leaves, anthers, roots, root tips, pistil, flower, seed and stalks.

15. A squash plant regenerated from the tissue culture of claim 13.

16. A method of vegetatively propagating the plant of claim 1, said method comprising the steps of:

(a) collecting tissue capable of being propagated from a plant according to claim 1;

(b) cultivating said tissue to obtain proliferated shoots; and

(c) rooting said proliferated shoots to obtain rooted plantlets.

17. The method of claim 16, further comprising growing at least a first plant from said rooted plantlets.

18. A method of introducing a desired trait into a squash line, said method comprising:

(a) crossing a plant of line ZGN-EH-09-7554 with a second squash plant that comprises a desired trait to produce F1 progeny, a sample of seed of said line having been deposited under ATCC Accession Number PTA-12566;

(b) selecting an F1 progeny that comprises the desired trait;

(c) backcrossing the selected F1 progeny with a plant of line ZGN-EH-09-7554 to produce backcross progeny;

(d) selecting backcross progeny comprising the desired trait and the physiological and morphological characteristics of squash line ZGN-EH-09-7554; and

(e) repeating steps (c) and (d) three or more times to produce selected fourth or higher backcross progeny that comprise the desired trait and otherwise comprises all of the morphological and physiological characteristics of line ZGN-EH-09-7554.

19. A squash plant produced by the method of claim 18, wherein the plant has the desired trait and otherwise com-

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prises all of the morphological and physiological characteristics of squash line ZGN-EH-09-7554.

20. A method of producing a plant comprising an added trait, said method comprising introducing a transgene conferring the trait into a plant of hybrid LEBEHH9044, or line ZGN-EH-09-7554, a sample of seed of said hybrid and line having been deposited under ATCC Accession Number PTA-12567, and ATCC Accession Number PTA-12566, respectively.

21. A plant produced by the method of claim 20, wherein the plant otherwise comprises all of the morphological and physiological characteristics of squash hybrid LEBEHH9044 or squash line ZGN-EH-09-7554.

22. The plant of claim 1, further comprising a transgene.

23. The plant of claim 22, wherein the transgene confers a trait selected from the group consisting of male sterility, herbicide tolerance, insect resistance, pest resistance, disease resistance, modified fatty acid metabolism, environmental stress tolerance, modified carbohydrate metabolism and modified protein metabolism.

24. A plant produced by introducing a single locus conversion into a plant of squash line ZGN-EH-09-7554, a sample of seed of said line having been deposited under ATCC Accession Number PTA-12566, wherein said plant comprises the single locus conversion and all of the morphological and physiological characteristics of squash line ZGN-EH-09-7554.

25. The plant of claim 24, wherein the single locus conversion confers a trait selected from the group consisting of male sterility, herbicide tolerance, insect resistance, pest resistance, disease resistance, modified fatty acid metabolism, environmental stress tolerance, modified carbohydrate metabolism and modified protein metabolism.

26. A method for producing a seed of a plant derived from at least one of hybrid LEBEHH9044, or line ZGN-EH-09-7554, said method comprising the steps of:

- (a) crossing a squash plant of hybrid LEBEHH9044, or line ZGN-EH-09-7554 with itself or a second squash plant; a sample of seed of said hybrid and line having been

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deposited under ATCC Accession Number PTA-12567, and ATCC Accession Number PTA-12566, respectively; and

- (b) allowing seed of a hybrid LEBEHH9044, or line ZGN-EH-09-7554-derived squash plant to form.

27. The method of claim 26, further comprising the steps of:

- (c) sowing a plant grown from said hybrid LEBEHH9044, or ZGN-EH-09-7554-derived squash seed to yield additional hybrid LEBEHH9044, or line ZGN-EH-09-7554-derived squash seed;

- (d) growing said additional hybrid LEBEHH9044, or line ZGN-EH-09-7554-derived squash seed of step (c) to yield additional hybrid LEBEHH9044, or line ZGN-EH-09-7554-derived squash plants; and

- (e) repeating the crossing and growing steps of (c) and (d) to generate at least a first further hybrid LEBEHH9044, or line ZGN-EH-09-7554-derived squash plant.

28. The method of claim 26, wherein the second squash plant is of an inbred squash line.

29. The method of claim 27, further comprising:

- (f) crossing the further hybrid LEBEHH9044, or ZGN-EH-09-7554-derived squash plant with a second squash plant to produce seed of a hybrid progeny plant.

30. A plant part of the plant of claim 7.

31. The plant part of claim 30, further defined as a leaf, an ovule, pollen, a fruit, or a cell.

32. A method of producing a squash seed, said method comprising crossing the plant of claim 1 with itself or a second squash plant and allowing seed to form.

33. A method of producing a squash, said method comprising:

- (a) obtaining a plant according to claim 1, wherein the plant has been cultivated to maturity; and
- (b) collecting a squash from the plant.

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